A remote setting mechanism for network enabled devices in the home environment

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The rapid development of Information Communication Technologies in recent years has allowed many devices such as smartphones and house consumer electronics being able to connect to networks. This has also led to an increase in home network equipment as well as an increase in services that rely on network contents. To enable their smooth operation, it is necessary to be able to configure and register such home equipment, which is a difficult task for the non-technical user. It is common for expert support staff to visit directly the houses of clients in order to perform tasks such as initial setup of devices and further troubleshooting. However, this is an expensive procedure that also does not scale with the number of clients. Therefore it is imperative to be able to provide remote support for such tasks. To improve the satisfaction and experience of customer support, in this research we propose a new mechanism for remote setting management of digital devices.

The IEC62608 reference model for management and operation of home network devices is currently being discussed in the TC100 workgroup. The proposed remote setting mechanism was designed with the IEC62608 model in mind.In the IEC62608 model, to discover and register devices inside the house, the HTIP protocol is used. The HTIP protocol can collect information regarding the home network topology and connectivity, as well as basic information of the connected devices. In the proposed remote setting mechanism, a remote setting manager is deployed inside the house and using the information gathered from HTIP is able to manage the settings of the connected devices. As device information, information such as category、manufacturer code, model number, device name, MAC / IP address information of the network interface and others is stored. In

addition, by storing more detailed information such as operation time, installed location and a list of the provided services, the proposed setting mechanism can provide even finer control of the devices. The prototype system uses information regarding the category、manufacturer code, device name, and connectivity information to provide an understanding of the network topology and the device specific settings. The relevant information is stored in an XML format, which makes it easier to add or remove information as needed. The DeviceInfo.xml file holds a list of all the devices that are connected to the network, whereas the TopologyInfo.xlm holds information regarding the network connectivity links among the devices.

in order to define the behaviour of the proposed remote setting mechanism, use case examples split into categories that capture scenarios such as deploying or relocating a device, scenarios during the operation of a service and troubleshooting scenarios were created. Multiple use cases exist in each category. For example, in the device deployment and relocation category, there are different use cases for the deployment of new equipment and the relocation of an already existing device. Furthermore, use cases such as the initial configuration of a device after deployment by downloading a settings file also exist. In total, 37 use cases were defined.

To demonstrate the validity of these use cases, a prototype system was developed. This system utilises the HTIP protocol, but since there is no open source implementation of the protocol so far, it had to be developed. The HTIP uses extensions for the LLDP and UPnP protocols in order to transfer device information. To implement HTIP, open source implementations of LLDP and UPnP were appropriately modified. Regarding LLDP, the vendor extension field was used, and further modifications were made in order to transfer device information such as category, manufacturer code, device name, device model, using new TLVs. The UPnP implementation already supports fields such as device name and model type in the Device Description Document, but it was further extended to accommodate the transfer of information regarding the category、and manufacturer code. With these extensions, it is now possible to transfer device information and confirm the connectivity (or lack thereof) of a device to the home network. The above device information can now be stored in the specifically designed DeviceInfo.xml file at the remote setting manager. All information sent to the remote setting manager is analysed and stored under pre-specified tagged elements that have well defined meanings. Using this stored information, the connectivity of a device to the home network can be confirmed, the remote setting manager can connect to a specific device as needed according to the use cases and finally specific settings can be applied to any connected device.

We evaluated whether the proposed remote setting mechanism can address all the problems that were identified in the use cases. In the TTC report TR-1053, various actual

problems such as the inability to use a service due to unexpected interaction with other services are described. For these problems, we conclude that the proposed use cases can handle all technical problems except problems that pertain to the user 's actual perception. For each use case, a concrete example is presented, and we demonstrate that it is now possible to use the information stored in the remote settings manager to resolve the given problem. Regarding the implementation, it is now possible to send and receive device information, and by completing the implementation it will be possible to apply any settings desired, as it was originally envisioned. With the proposed remote setting manager, it is now possible to change the settings of a device remotely, and to automate the process of initial set up and network troubleshooting of devices.